MAKING MODERN LIVING POSSIBLE

DLX
Installation Guide

DLX 2.0 - DLX 2.9 - DLX 3.8 - DLX 4.6

SOLAR INVERTERS

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1. Product Overview

This *Installation Guide* contains all the necessary install information to connect and start up the *DLX* inverter. The inverter must be used in compliance with the *DLX User Guide*, which is to be found at *www.Danfoss.com*.

1.1. Symbols Used

The warning symbols used in this *Installation Guide* highlight **important information** on how to avoid shock hazards to equipment and persons. **Pay particular attention when the symbols appear!**

Table 1.1: Warning symbols appearing in this guide

Symbol	Description
	DANGER: Situations where an immediate hazard could cause serious injury or death to workers and/or the general public if not avoided.
	WARNING: Situations where a potentially hazardous condition exists that could result in the death or serious injury of workers and/or the general public if not avoided.
	CAUTION: Situations where a non-immediate or potential hazard presents a lesser threat of injury that could result in minor or moderate injuries to workers and/or the general public.
	NOTICE: Situations where a non-immediate or potential hazard presents a risk to damage of property and equipment. May be used to indicate important operational characteristics. There is no *Safety Alert* or attention symbol present in this situation.

1.2. Product Label

The product label contains important identification parameters and characteristics for the inverter, and must be clearly visible after installation.

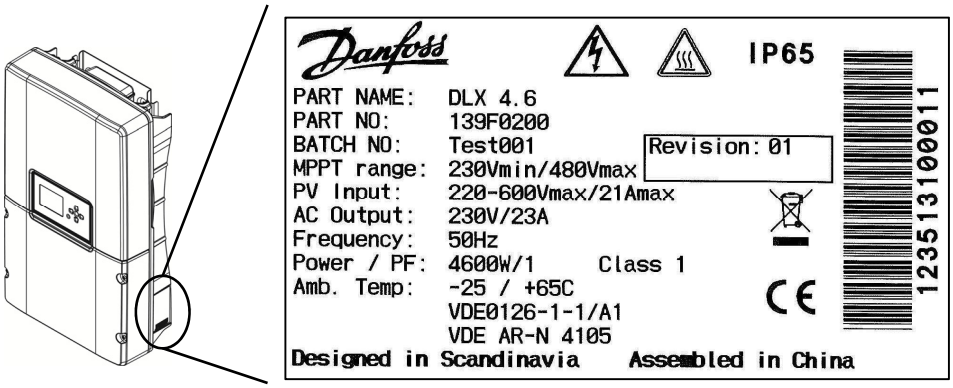


Figure 1.2.1: Product Label

Table 1.2: Symbols appearing on the product label

Symbol	Description
	Discharge time: High voltages may be present inside the inverter for 1 hour after switch OFF
	Refer to *User Guide*: Look for further details in the *User Guide*, which is available on the Danfoss website
	Hot Surface: The heat sink on the back of the inverter can reach temperatures up to 90 °C
	Danger: High voltages are present
	Disposal: Do not dispose in general waste! Collect the various parts separately and recycle them according to local regulations
	CE Marking: The product meets the EU safety, health and environmental protection requirements
	S – NO: Serial Number for inverter identification

1.3. Unpacking and Inspection

After unpacking the inverter safely, check that all components are present and in an undamaged condition. If damaged, contact your supplier immediately!

1.3.1. Lifting and Carrying the Inverter

Considering the inverter's weight of **20-22 kg**, (depending upon model), lifting and carrying the inverter must be correctly performed to prevent back injuries.

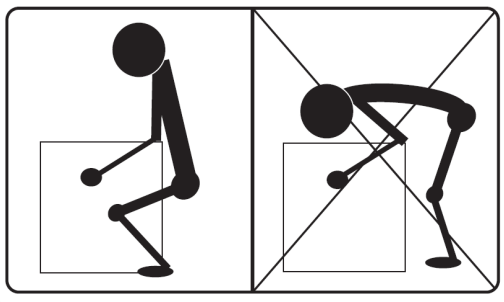


Figure 1.3.1: Correct lifting of the inverter

- When lifting, bend the knees, and keep the back straight.
- Lift carefully; hold the inverter close to the body and let the leg muscles do the work.
- Turn the whole body as one unit to avoid twisting the lower back.
- Carry the inverter close to the body.

1.3.2. Unpacking

- Place the box in position, with the top clearly visible and according to the arrow marking on the packaging.
- Cut the seal, and open the box.
- Take out the lock clip, the bag with accessories and the *Installation Guide* lying on the upper section of the foam packaging material.
- Remove the upper part of the foam packaging material.
- Both sides of the inverter case are narrowed in order to get a better grip on the device. Lift up the inverter carefully out of the box using the "*handles*" illustrated in *Figure 1.3.2*.
- Remove the lower section of the foam packaging and take out the inverter mounting bracket.
- Store all the original packaging for possible later reuse.

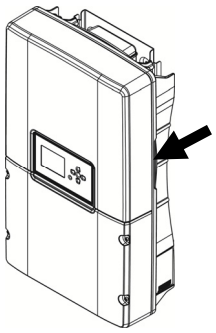


Figure 1.3.2: "Handles"

After unpacking the inverter safely, check that all components are present and in an undamaged condition.

1.3.3. Scope of Delivery

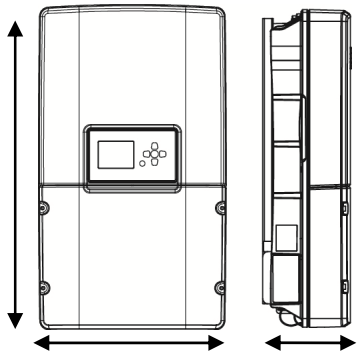
- *DLX* single phase inverter
- Mounting bracket
- Installation Guide
- Accessories: grounding strap, bracket screws, lock clip, extra type label

NOTICE

The mating parts of the connectors are not part of the standard scope of supply, and must be provided by the system installer.

1.3.4. Inverter Structure

The housing of the *DLX series* inverter is designed for indoor and outdoor use (IP65), and provides a degree of protection from dirt, rain, sleet, snow, dust, water, and corrosion.



H: 610 mm
W: 353 mm
D: 158 mm

Figure 1.3.3: Mechanical dimensions

The front surface of the inverter consists of an upper and a lower cover.
The upper cover may only be removed by *Danfoss* authorized personnel. Removal of the upper cover by unauthorized persons voids the warranty!
The lower cover protects the connection area, and may be removed by the system installer for electrical connection and maintenance of the inverter.

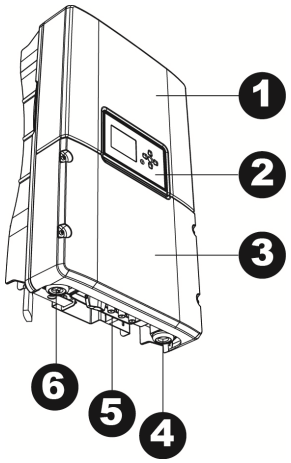


Figure 1.3.4: Inverter structure

1. Upper cover
2. User Interface
3. Lower cover; customer connection area
4. AC output
5. DC input
6. Network input

DANGER

Always disconnect the PV array cables from the inverter after turning the AC and DC OFF, but before removing the covers, as the PV array can supply up to 600 VDC to the inverter when exposed to sunlight.

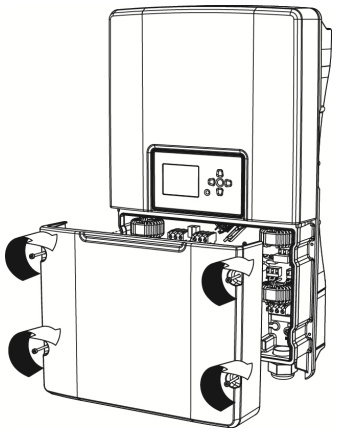


Figure 1.3.5: Lower cover

- Loosen the four screws on the lower cover with a 4 mm hex key, according to the figure.
- Take the cover off carefully.
- Store the lower cover and screws safely to avoid loss or damage.

- Fasten the screws on the lower cover with a torque of 1.0 Nm.

CAUTION

Never remove the inverter lower cover in wet conditions! Removal of the inverter lower cover during rain or in damp conditions can damage sensitive internal electronic components.

2. Installation

The *DLX* inverters contain **no** user-serviceable parts, and **installation and maintenance must be performed by qualified persons**, who have a qualified knowledge of the local and national electrical regulations and who follow the instructions in this *Installation Guide*.

NOTICE

The *DLX series* is a grid interactive (grid-tie) inverter and must be used exclusively for its designed purpose, which is to convert PV-generated DC electricity into AC electricity to feed into the grid.

NOTICE

The *DLX series* require minimum 7W PV power and a DC voltage above 230V for commissioning. An installation cannot be finished without 7W PV power. A small DC power supply can be used.

- The inverter must be operated in its original and technically intact condition without any unauthorized modifications.
- Always keep the values of operation within the limits given in the technical specifications, due to the risk of possible inverter damage.

WARNING

The safety precautions and instructions in this *Installation Guide* must be read thoroughly to be able to install and operate the inverter properly to prevent death, injury or material damage.

2.1 Safety Equipment Required for Grid Connected Systems

Ensure compliance with the local and national electrical regulations to satisfy the safety equipment requirements.

NOTICE

The system installer is responsible for providing safety equipment that meets the requirements for both the DC and AC operations, and to protect the equipment and prevent personal injury, as per the local and national electrical regulations.

2.1.1. Disconnection Devices

Disconnection devices, **switches or circuit breakers**, enable a shut-off from the power source during operation. They protect the current-carrying conductors and other system components from power surges and system malfunctions, and help to shut down the inverter safely for maintenance and repairs.

- Both AC circuit breaker(s) and DC switch(es) are recommended to facilitate maintenance work and repairs of the inverter.
- The disconnect devices must conform to the local and national electrical regulations, and have an interrupt rating sufficient for the voltage and current available in the circuit.
- Each disconnection device must be readily accessible and operable without exposing the operator to live parts. All devices must be permanently marked for their purpose.

2.1.2. Overcurrent Protection Devices

Overcurrent protection devices, **fuses or circuit breakers,** prevent the circuit conductors from overheating as a result of overload, short circuit or ground fault.

- An overcurrent protection device is required on every current carrying conductor.
- If a fuse blows or a circuit breaker trips the cause should always be determined before replacing or resetting them.
- It is recommended to install an ***RCD*** (Residual Current Device) of ***type A*** between the AC grid and the inverter, to be able to detect leakage current and interrupt fault paths. The needed detection range must comply with the relevant local and national electrical regulations!

2.2. Mechanical Installation

The mounting surface and the mounting method must be suitable for the inverter's weight, dimensions and possible housing temperature. This is crucial to maintaining the efficiency of the inverter!

WARNING

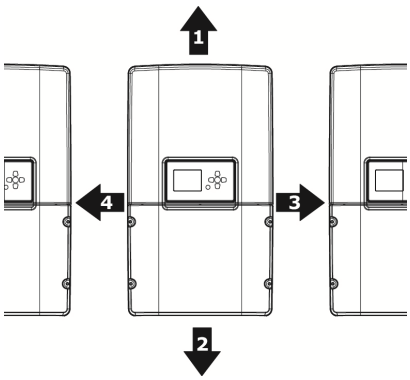
Correct installation prevents the inverter from falling from the wall! The mounting surface must be suitable for the weight 20-22 kg and temperature (90 °C) of the inverter.

CAUTION

Protect the inverter from flammable and explosive environments, as the inverter heat sink can reach temperatures up to 90 °C during long-periods of high performance.

- The inverter is suitable for outdoor operation, but should be sheltered from direct sunlight, snow, rain, dust and sand.
- Location should be in proximity to the PV arrays to minimize DC losses.

Avoid enclosed areas with poor air flow! Sufficient ventilation is needed to prevent temperature build up inside the inverter and hence possible power losses. Observe the minimum distances specified below to maintain optimal cooling:



1. 400 mm
2. 300 mm
3. 150 mm
4. 150 mm

Figure 2.2.1: Minimum distances for optimum cooling

For optimal operating conditions, the ambient temperature must be between -25° C & +65° C, and non-condensing relative humidity between 4 % and 99 %.

NOTICE

Direct sunlight may cause yield losses, as direct sunlight causes increased internal temperatures that can lead to reduced power output. Also, direct sunlight may cause degradation of the LCD screen quality.

CAUTION

Ensure a location where people cannot accidentally come in contact with the rear inverter surface, due to temperatures up to 90°C.

2.2.1. Wall Bracket

Depending on the mounting surface, different mounting methods may be required to secure the wall bracket.

- The system installer is responsible for selecting the correct type and number of fixings suitable to support the weight on the mounting surface.
- The bracket is designed to withstand 80 kg
- The inverter must be mounted in a vertical orientation.
- Keep the lower cover closed when mounting the inverter to avoid damage to internal components.
- Mark the bracket holes on the mounting surface using a spirit level and the bracket as a template to ensure the inverter is level.
- Fasten the bracket to the mounting surface with the required number of fixings to support the hanging weight of the inverter.

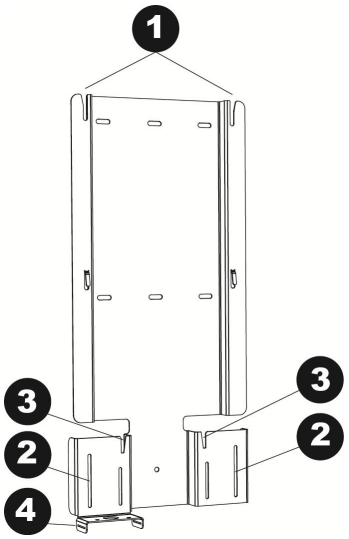


Figure 2.2.2: Inverter bracket

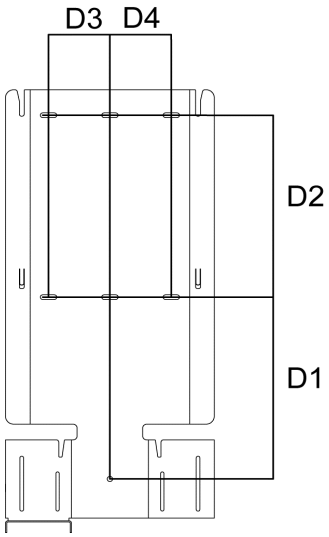


Figure 2.2.3: Distances between fixing screws

1. Carrier slots for the inverter
2. Steering slots for the inverter
3. Carrier slots for the Stringbox
4. Fixing clip

D1. 232.5 mm
D2. 232.5 mm
D3. 75 mm
D4. 75 mm

2.2.2. Inverter

Attach the inverter to the mounting bracket as follows:

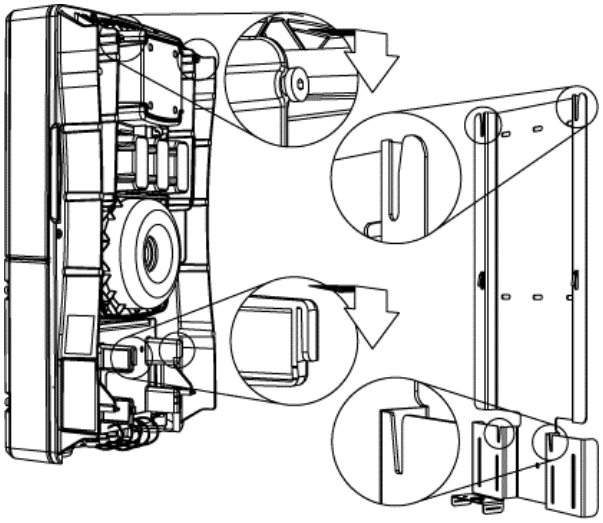
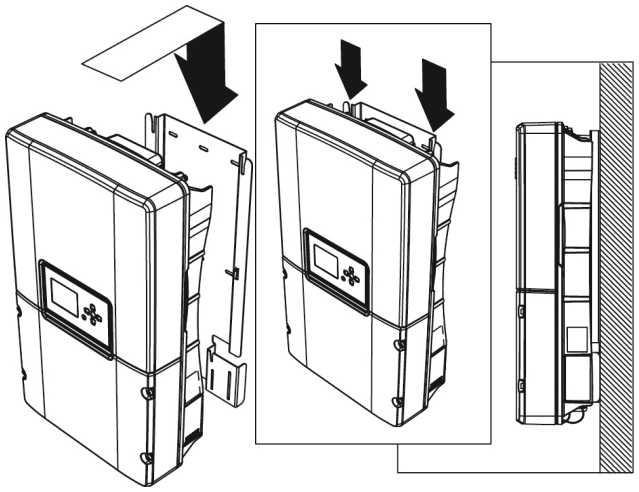


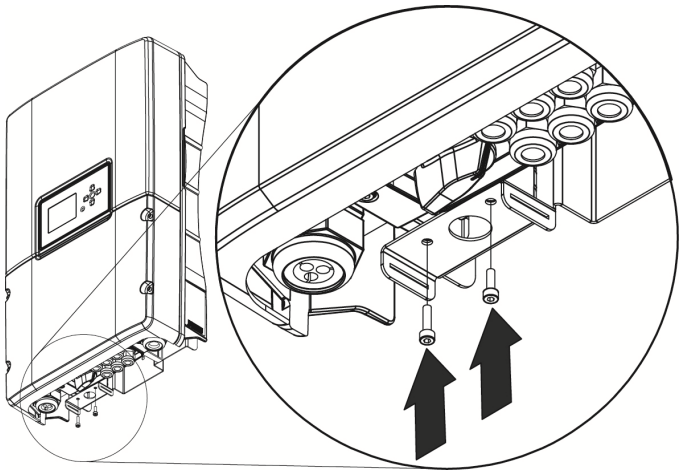
Figure 2.2.4: Hooks on the back of the inverter

- Locate the hooks for the carrier slots on the upper back and the hooks for the steering slots on the lower back of the inverter.
- Use the locating pins on the Stringbox.



- Lift the inverter up and guide the upper hooks into the slots on the bracket.
- Control the lower hooks into the slots and slide the inverter onto the bracket.

Figure 2.2.5: Mounting Inverter onto bracket



- Ensure that the inverter is correctly mounted, and tighten the lock clip with one screw into the inverter and one into the Stringbox.
- Apply a torque of 1.0 Nm

2.3. Checks Prior to Installation

☑ Make sure that the AC circuit breaker(s) and the DC switch(es) are OFF and that the terminals are in a discharged state to prevent shock hazards.

DANGER

Contact with energized ports may cause lethal injuries! All installation of the inverter must be performed with circuits de-energized!

☑ All electrical installations shall comply with the local and national electrical regulations in force at the installation site.
☑ Check that the PV and the grid characteristics are compatible with the inverter characteristics. Refer to *9. Technical Data*
☑ Check that the inverter is properly fastened and secured to the bracket.
☑ Ensure that the conductors and circuit breakers/fuses are properly sized to comply with the national electrical regulations.

☑ Ensure that the conductors are listed for PV applications and the site environment, and that they have the correct color coding.

2.4. Electrical Installation

Contact the local utility company for interconnection agreements and power approval before connecting to the grid.

Correct electrical connection is critical for achieving a safe, long-term and reliable operation of the entire PV system.

NOTICE

Only persons who are qualified to install high voltage electrical equipment and are familiar with the electrical regulations applicable to the installation site may install the inverter. This is to ensure a safe connection and avoid electrocution!

DANGER

Never work with live wires! All work on the inverter must be performed with disconnected terminals, as contact with live wires may cause serious injury or death!

2.4.1. Connection Area

The **DC connections** are achieved by the use of a Stringbox with DC switch and three sets of DC connectors. The connection of the **AC and the network** cables are with screw terminals and a RJ45 connector.

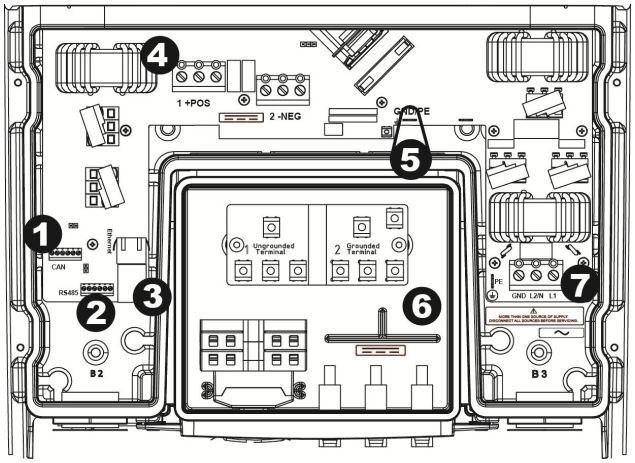


Figure 2.4.1: Stringbox with DC switch

1. CAN bus terminal
2. RS-485 terminal
3 Ethernet port
4. Internal DC terminal blocks, ***+POS*** and ***-NEG***
5. Internal DC ground receptacle, ***GND/PE***
6. Stringbox equipped with DC switch
7. Internal AC terminal block

2.4.2. Grounding

Appropriate grounding of the entire PV system limits voltage surges, gives a common reference point for the conductive parts and facilitates the operation of the overcurrent devices.

NOTICE

- Grounding must be carried out by qualified persons only and comply with local and national electrical regulations.
- Follow the safety instructions and specifications from the different PV module manufacturers regarding grounding requirements.

- The PV strings may be ungrounded, or grounded through either the negative **or** the positive string conductors.
- The grounded DC conductors are connected to ground via the grounding strap.
- The grounded conductors must be sized according to the local and national electrical regulations, and only carry current when electrical malfunctions occur.
- All metal parts of the DLX inverters are electrically bonded to ground through the terminal labeled ***GND*** in the AC terminal block.

CAUTION

If the positive **or** negative PV conductors are grounded, then the grounding strap must be connected to the ***DC ground terminal*** and the system must **NOT** be grounded at any other point, as voltage potentials can appear and possibly damage electrical components.

A minimum cross section area of 6.0 mm^2 / 10 AWG is required for the ground wire connection.

2.4.3. DC Connections (PV)

The DC connections include wiring from the PV modules, through the combiner box, to the inverter.

DANGER

Always disconnect the PV array before starting the connection on the DC side! Charged DC terminals pose a risk of serious injury or death as the PV array can supply up to 600 V_{DC} to the inverter when exposed to sunlight.

WARNING

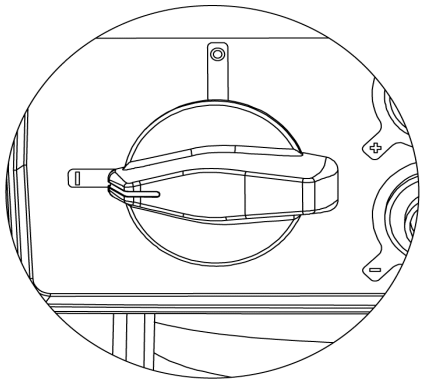
Never remove cables during operation! The inverter is charged with high voltages, and removal of cables during operation may cause arcing

NOTICE

Maximum Voltage: The open circuit voltage, V_{OC}, must never exceed 600 V_{DC} under any conditions. The voltage generated by PV modules is inversely proportional to the temperature; at lower temperatures the PV voltage increases from the nameplate rating and at higher temperatures the PV voltage decreases from the nameplate rating.

NOTICE

Ensure the DC switch in the Stringbox is in the OFF position, when removing the lower cover to access the connection terminals.

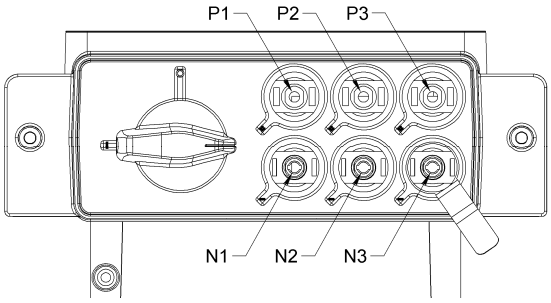


0 = OFF
I = ON

Figure 2.4.4: DC switch

2.4.3.1. Stringbox with DC switch

The Stringbox is equipped with DC switch and plug-in connectors.



P1, P2, P3:
Positive connectors
N1, N2, N3:
Negative connectors

Figure 2.4.5: Optional DC connectors and DC switch

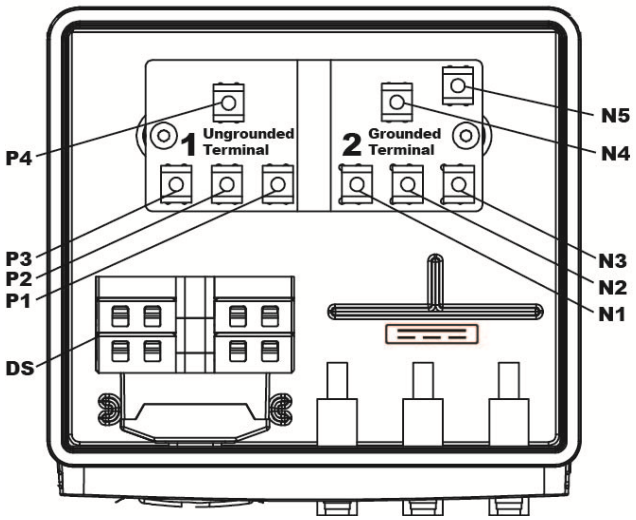


Figure 2.4.6: Stringbox with DC switch

P1, **P2**, **P3:**
Ungrounded terminals
N1, **N2**, **N3:**
Grounded terminals

N4: Grounded terminal
N5: Terminal for the grounding strap
P4: Ungrounded terminal

DS: DC Switch

Negative Grounded PV String

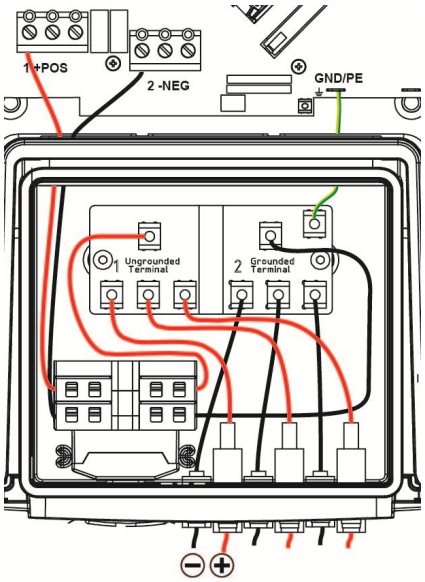


Figure 2.4.7: Negative grounded PV string

- The inverter is delivered from the factory in an **ungrounded PV string configuration** as standard.
- Connect the **grounding strap** between ***N5*** in the Stringbox (*fig. 2.4.6*) and the ***DC ground receptacle*** labelled ***GND/PE*** in the inverter lower compartment.

Positive Grounded PV String

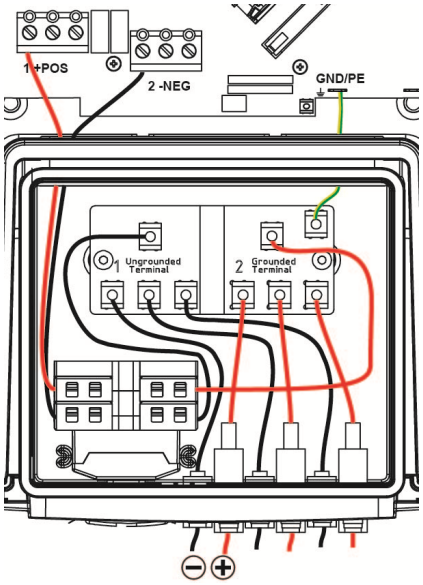


Figure 2.4.8: Positive grounded PV string

- Connect the **positive connectors (+)** to the terminals labelled ***2.Grounded*** and the **negative connectors (-)** to the terminals labelled ***1.Ungrounded***.
- Switch the conductors connected to ***N4*** and ***P4*** (*fig. 2.4.6*).
- Connect the **grounding strap** between ***N5*** in the Stringbox (*fig. 2.4.6*) and the ***DC ground receptacle*** labelled ***GND/PE*** in the inverter lower compartment.

2.4.3.2. Connection Procedures

- The DC conductors connecting the PV array to the inverter must each have a minimum rating of 600V_{DC} at all given operating temperatures.
- The DC conductor cables must be sized for correct temperature rating and sunlight resistance. Use copper wire with a cross-section area of between 6 mm^2 to16 mm^2 / 10 AWG to 6 AWG and temperature rating 90° C for all connections. Ensure compliance with the relevant national electrical regulations!
- Conductor insulation rating must be higher where the backs of the modules cannot receive cooling or where the ambient temperature exceeds 40° C. Note the relevant national electrical regulations!

String Connectors

- The corresponding mating connectors must be provided by the system installer.
- Follow the guidelines from the connector manufacturer when choosing cable sizes and assembling them in the connectors.
- Plug in the connectors and hand-tighten them to the corresponding connector on the inverter.
- Check if the contacts are firmly tightened by pulling them gently.
- Only valid for France: Removal of the connectors requires a special tool. Note the relevant national electrical regulations!

2.4.3.3. Reversed DC Connection

If the positive and negative conductors are connected to the wrong terminals, the inverter will not start up. The inverter is not damaged due to internal reverse blocking diodes, but high currents are generated in the conductors.

DANGER

Be aware of high currents! If the DC terminals are mixed up during connection, high currents are generated in the conductors, which can pose shock hazards.

Procedure

- Turn OFF the DC switch(es) and the AC circuit breaker(s).

DANGER

The PV conductors are still charged after the DC switch in the Stringbox is turned OFF, due to power fed from the PV modules. Always turn OFF the remote DC switch and wait until the PV modules do not feed power.

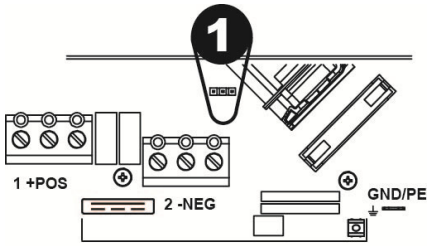
- Remove the PV connectors.
- Check with a voltmeter if the terminals are discharged.
- Disconnect the conductors from the terminal block.
- Connect the conductors to the correct terminal block.
- Test the polarity using a voltmeter before turning ON the DC switch(es) and the AC circuit breaker(s).

2.4.3.4. Jumper Position for the System Grounding Setup

The jumper above the - *NEG* terminal in the customer connection area monitors the arrangement of the DC connection according to the grounding setup. When delivered, the jumper is positioned for an ungrounded string. Depending on the requirements from the module manufacturer, the jumper must be pulled up and positioned correctly to match the grounding of the DC conductors.

In case of discrepancy the following message will appear in the display: "*Fuse fault.*"

Table 2.4.1: Jumper position for the grounding setup

Connection Area	Top view	System
		**Ungrounded PV String Configuration:** There is no connection between the pins.
		Positive grounded PV String Configuration: The jumper short-circuits the two leftmost pins.
		Negative grounded PV String Configuration: The jumper short-circuits the two rightmost pins.

2.4.4. AC Connections (Grid)

The AC connection includes wiring from the AC distribution panel through one or more circuit breakers to the AC terminal block of the inverter.

Verify that the AC grid specifications are compatible with the inverter characteristics before connecting the inverter to the grid:

- Single phase / Split phase
- Voltage range (184 – 276 V_{AC})
- Frequency range (50 Hz ±5 Hz)

DANGER

Turn OFF the AC circuit breaker before connecting the inverter to the AC grid to prevent electrocution.

The *DLX* series are single phase output inverters, which are designed so that they can be connected to a three-phase system. When several inverters are connected together, they must be distributed evenly between the grid phases.

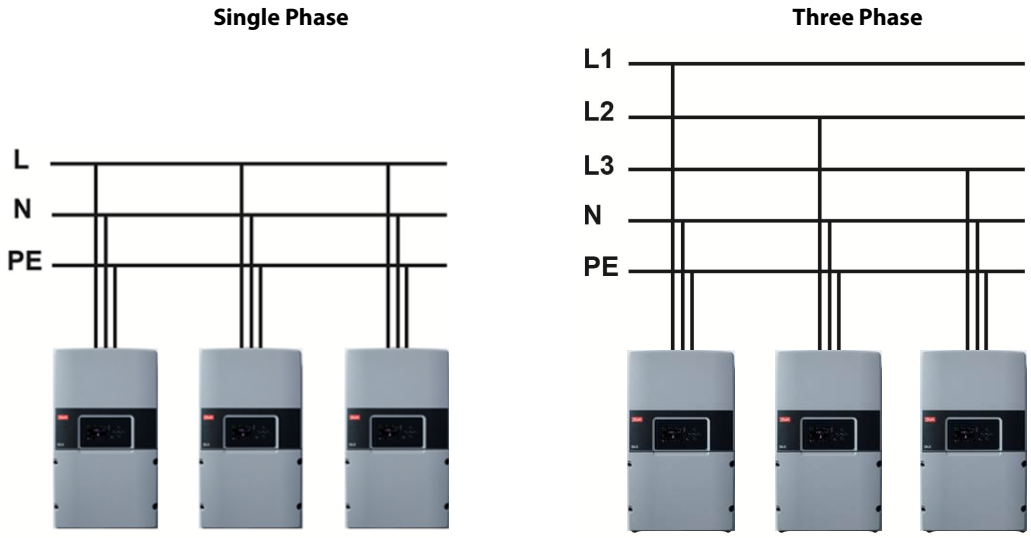


Figure 2.4.9: Example inverter AC connections

Table 2.4.2: The different AC conductors

Term (Abbr.)	Description
Phase conductor (*L1/L2/L3*)	The ungrounded live conductors, which carry current to the load.
Neutral conductor (*N*)	In a single phase system the neutral conductor is a circuit conductor carrying the same amount of current as the ungrounded phase conductors.
PE (Protective Earth / Ground) conductor	An electrical path to ground, designed to carry fault currents.

2.4.4.1. Connection Procedures

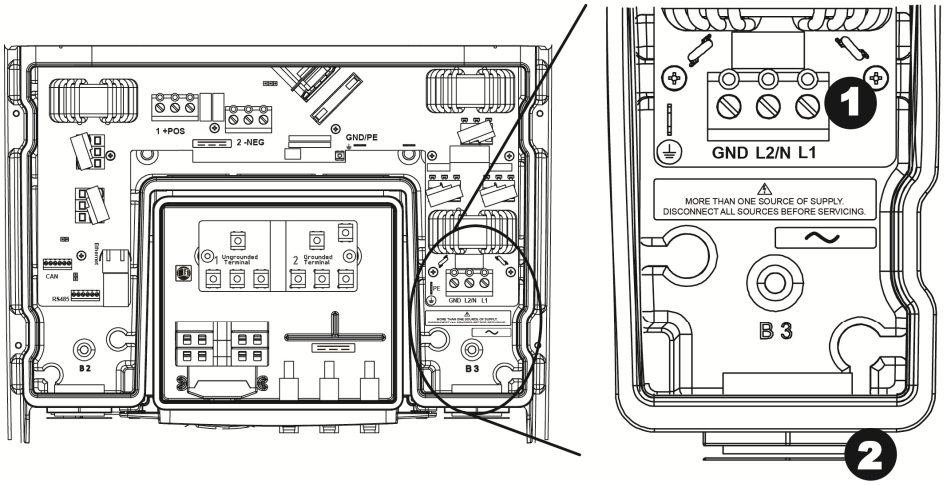


Figure 2.4.10: Connection area with AC terminals

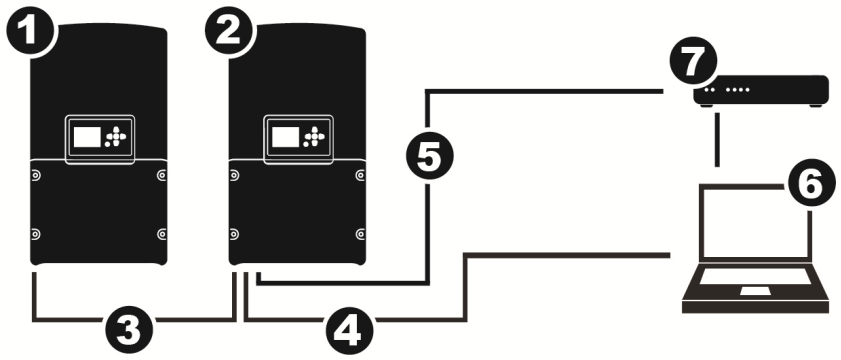
1. AC terminal block:
- ***GND**:* Ground terminal
- ***N***: Neutral terminal (TN/TT) or Phase terminal (IT)
- ***L***: Phase terminal

2. Cable gland

- Use copper wire with a maximum cross-section area of 16 mm^2 / 6 AWG. Ensure compliance with the relevant national electrical regulations!
- The AC conductor resistance should be minimized.
- Unscrew the cable gland locknut.
- Guide the AC cable through the opening, and connect the conductors to the corresponding terminals in the connection area:
    - Phase conductor (L1 or L2 or L3) to ***L***
    - Neutral conductor (TN/TT) or Phase conductor (IT) to ***N***
    - Grounded conductor to ***GND***
- Tightening torque of the terminal screws is 1.5 Nm
- Double check if the connection is correctly carried out.
- Hand-tighten the gland locknuts to seal the cable gland.

2.4.5. Network Connections

The inverter is equipped with three communication interfaces: Ethernet, CAN, and RS-485. **Ethernet** provides communication between the integrated web server and a computer, either directly or via a router/switch. **CAN** allows communication between several DLX inverters. **RS-485** allows communication with Danfoss compatible third party products or to Danfoss CLX products.



1. Follower inverter
2. Master inverter
3. CAN bus cable
4. Ethernet cable
5. RS-485 cable
6. Computer
7. Data logger

Figure 2.4.11:Connection without network

2.4.5.1. Connection Procedures

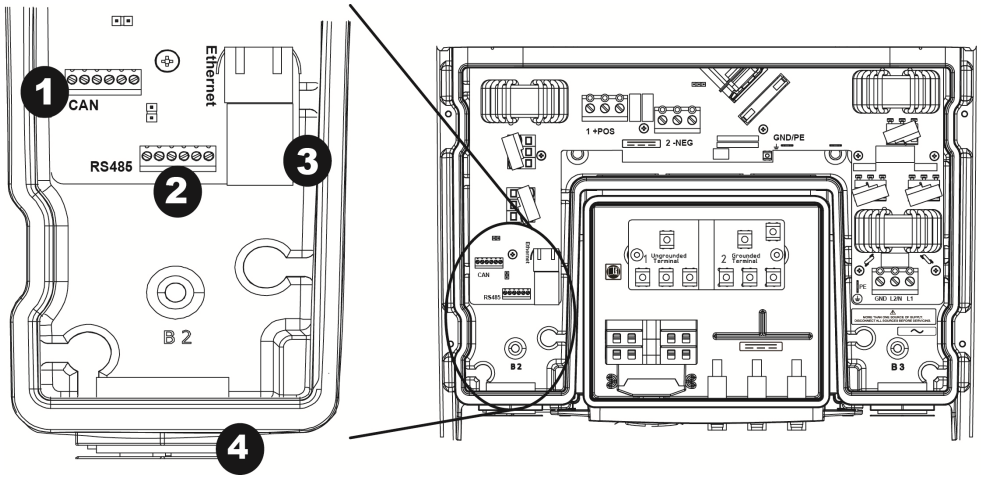


Figure 2.4.12: Connection area with network terminals

1. CAN bus terminal
2. RS-485 terminal
3. Ethernet connector
4. Network cable gland

NOTICE

If multiple inverters are connected together, all inverters must be connected to the CAN bus before *Start Up* to benefit from single installation setup.

- **Ethernet:** Use CAT5e or better, with size 0.21 mm^2 /24 AWG, with a maximum total length of 100 m.
- **CAN:** Use CAT5e or better, with size 0.21 mm^2 /24 AWG, with a maximum total length of 500 m.
- **RS-485:** Use CAT5e or better, with size 0.21 mm^2 /24 AWG, with a maximum total length of 1200 m
- Unscrew the network cable gland, and take out the grommet.
- Three-way cable gland insert:

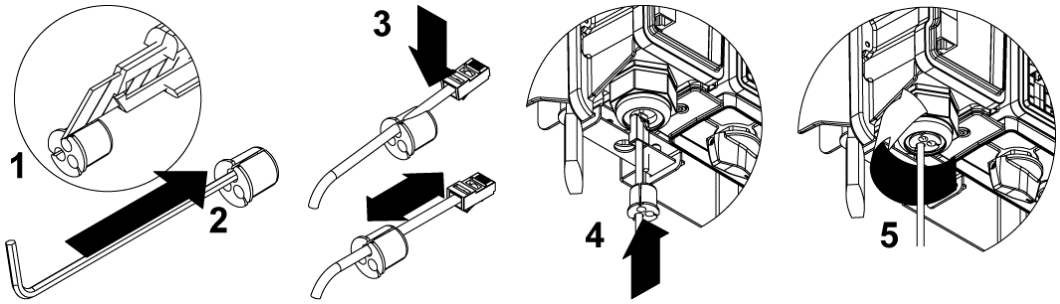


Figure 2.4.13: Insertion of the network cables in the cable gland

1. Conductors with connector: cut through the grommet with a width of about 1mm. With no connector: no cutting is necessary
2. Remove the plug from inside the grommet.
3. Assemble the cable in the gap. Repeat step 1 – 3 if more cables.
4. Guide the assembly into the cable gland.
5. Connect the cables to the terminals in the connection area as follows:

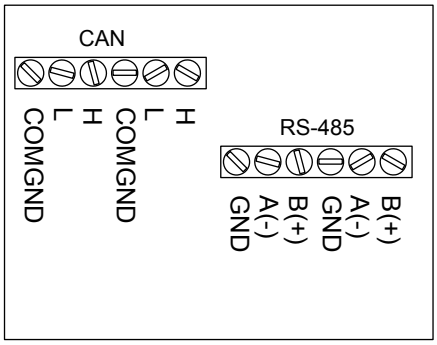
- Ethernet:	Plug the Ethernet cable directly into the RJ45 socket.
- CAN:	The conductors must be connected to the same labeled terminals at both ends, i.e. ***H*** connected to ***H***, ***L*** to ***L*** etc. Recommended tightening torque is 0.2 Nm / 0.15ft-lbf.
- RS-485:	The conductors must be connected to the same labeled terminals at both ends, i.e. ***A*** connected to ***A***, ***B*** to ***B*** etc. Recommended tightening torque is 0.2 Nm / 0.15ft-lbf.

6. Tighten the cable gland firmly.

NOTICE

Cable shielding: It is recommended to mount the cable shielding for both the CAN and RS-485 with the GND at the receivers end.
If any kind of datalogger is connected to an inverter, then only mount the shield at the datalogger.
If the system consists of two or more inverters, then only mount the shield at the "Master"

CAN and RS-485 connection pinout

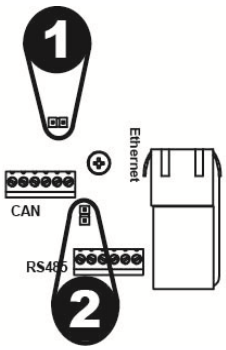


2.4.5.2. Jumper Position for Termination Resistance

With multiple inverters connected the jumper located behind the CAN / RS-485 terminal activates the termination resistance when the pins are terminated (short-circuited). This minimizes signal reflections in the cables and helps to avoids interference.

- **Single inverter:** The two pins must be terminated (*Default*).
- **Several inverters connected**: The master-follower configuration requires terminated pins on the first inverter and on the last inverter in the linked series. The pins must be disconnected on the inverters between the first and last inverters in the linked series.
- To disconnect the pins, the jumper must be pulled up and placed only on one of the pins.
- Be careful not to bend the pins when removing or installing the jumper!

Table 2.4.3: Jumper for multiple inverters in linked series

Network connection	Jumper Position	Pins
		The pins are terminated.
		The pins are disconnected.

1. *CAN termination resistance*
2. *RS-485 termination resistance*

2.5. Required Safety Equipment

Safety equipment includes **switches or circuit breakers** to disconnect power sources, **fuses or circuit breakers** to protect conductors from overheating and **surge protection** to protect the equipment from voltage bursts and surges.

NOTICE

Safety Equipment: The system installer is responsible for providing safety equipment that meets the requirements for both the DC and AC operations to protect the equipment and prevent personal injury.

2.6. Checks before Start Up

☑ **Mounting:**
- Check that the bracket and the inverter are correctly mounted and secured.

☑ **PV wiring:**
- Check that the PV cables are rated for the PV current and for the present environmental conditions.
- Check that the wiring is performed according to local and national electrical regulations.

☑ **Connection:**
- Check that the PV conductors are correctly torqued to the DC terminals.
- Check that all connectors and cable glands are correctly tightened and sealed.

☑ **DC side:**
- Verify that the PV open-circuit voltage (V_{OC}) **does not exceed** 600 V_{DC}
- Check that the DC polarity is correct.

☑ **AC side:**
- Verify that the AC conductors are correctly connected to the AC terminals.

☑ **Grounded conductors:**
- Check that the grounded conductors are properly sized, and **not** fused or switched.

☑ **Jumpers:**
- Check that the jumpers for the grounding setup and for the termination resistance are correctly positioned according to the grounding setup.

☑ **Disconnects:**
- Ensure that all current-carrying conductors on both the DC and AC sides have a switch, and that the switch is located correctly and is readily accessible.

☑ **Overcurrent protection:**
- Ensure that the overcurrent protection on both the DC and the AC sides are rated correctly, and capable of being changed without touching live contacts.

☑ **Inverter cover:**
- Ensure that no cables interfere with the sealing of the inverter lower cover, and fasten the cover firmly to the housing. Recommended tightening torque is 1.0 Nm

CAUTION

Verify that the lower cover is correctly tightened, so that no moisture enters the housing and damages the electronic components.

3. Start Up

A minimum available voltage of **184 V_{AC}**, **230 V_{DC}** and a power greater than **7 W_{DC}** is required before the inverter starts feeding power to the grid.

AC side

- Turn ON the AC circuit breaker(s).

DC side

- Turn ON the DC switch(es).

3.1. Initial Start

When the inverter is started for the first time, an installation menu is automatically displayed to enable the configuration of certain critical values and operational settings.

3.1.1. Customizing the Inverter Settings

Single Inverter

- When both the DC and the AC switches are turned ON and the inverter is supplied with enough power, an installation menu is displayed in the LCD screen.

Multiple Connected Inverters

1. CAN

- Connecting all inverters via the CAN bus enables the configuration of all inverters in a plant via one inverter. The *Start Up* can then be carried out on any inverter, and if configured as the *master* inverter the configuration settings of *time*, *date*, *language* and *grid settings* will be transferred to all the other *follower* inverters on the network.
- Each *follower* inverter is automatically assigned an ID number from the *master* during *Start Up*.

2. RS-485

- Connecting the inverters via the RS-485 bus enables communication with third party equipment.
- Each inverter must manually be assigned an ID, a bit rate number and a parity number:

  - The ID number must be between 1 and 247.
  - Both the *master* inverter and the *follower* inverters need a bitrate number and a parity number. Compare with the setup in the third party equipment (eg. an external data logger) and write this number in the inverter's network menu. Refer to section *6.2.4.2 Network Setup* of the *User Guide* for more details.
    Defaults are: bitrate – *19200* and parity – *none*.

3.1.2. User Interface

The *User Interface* on the front of the inverter contains a LCD screen, three LEDs and six function keys.

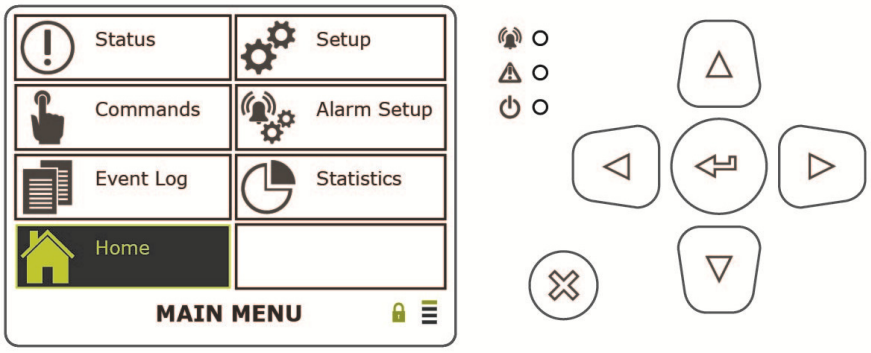


Figure 3.1.1: Inverter user interface

- To activate the display when the screen saver is active (blank), press any key.
- With sufficient AC power the display shows the *Start Up* screen.

3.1.2.1. Function keys

The function keys have the following uses:

Table 3.1: Function keys

Symbol	Function	Symbol	Function
△	***Up*:** Scroll up / increase value	▷	***Right:*** Navigate one page or value right
▽	***Down:*** Scroll down / decrease value	⏎	***Enter:*** Select option / go to next level
◁	***Left:*** Navigate one page or value left	✕	***Cancel:*** Stop operation / back to previous menu item

- The selected item is always highlighted in yellow.
- A registered touch of a button causes a "*click*" sound to be heard.

3.1.2.2. LED

There are three LEDs next to the display screen. The upper one is red, the middle is yellow and the lower one is green.

Table 3.2: LEDs.

Symbol	LED	Function	Action
	Red	Malfunction! Inverter in shutdown mode	Look for alarms in *Active Alarms*
	Green & Yellow	Caution! Inverter still operates, but at a limited level	Look for warnings in *Active Alarms*
	Green	Operates; inverter feeds power to the grid	No action
NONE	**Yellow**	Inverter is OFF (Power < $7W_{DC}$)	No action

3.1.2.3. LCD Screen

To navigate in the LCD screen the six function keys must be used. By selecting one of the seven items in the *Main Menu,* a further navigation through different submenus is possible. There are four different menu levels.

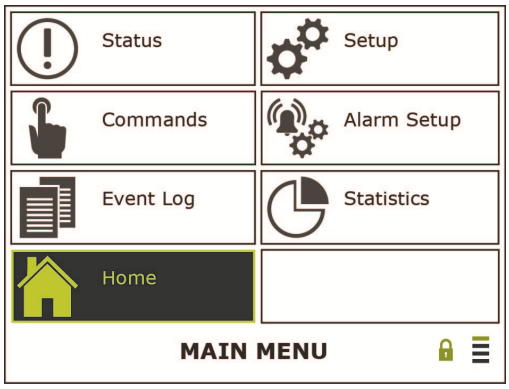


Figure 6.2.1: Main Menu

Home**, **Status**, **Event Log, Statistics:
The information and values are read-only.

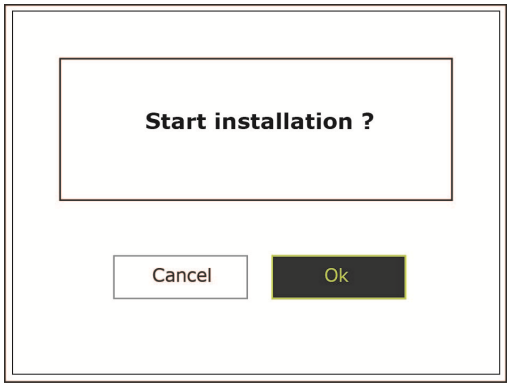
Setup**, **Commands, Alarm Setup:
The information and values can be modified.

Padlock: Opens up when correct password is entered.

Lines: Number of highlighted lines indicates the current menu/submenu level, with the top line being the first level (*Main Menu*).

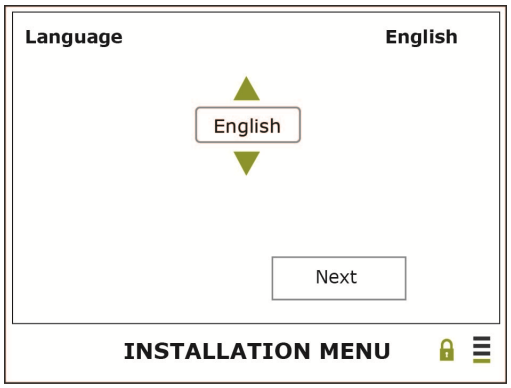
3.1.3. Start Installation configuration

1. Start



Left – Cancel
Right – OK
Enter – Confirm

2. Language Selection

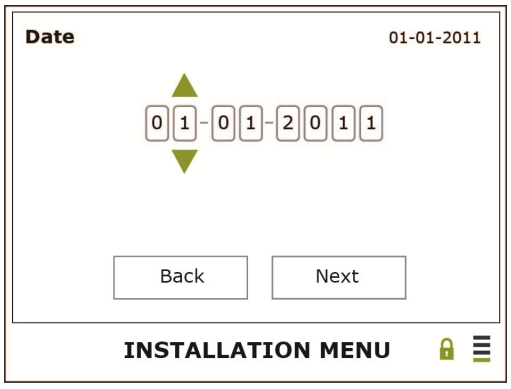


Default – English

Enter – Call up the list of languages
Up or ***Down*** – Navigate through the list to find the preferred language; *English*, *German*, *French*, *Spanish*, *Italian, etc.*.
Enter – Confirm

Right – Next
Enter – Confirm

3. Date

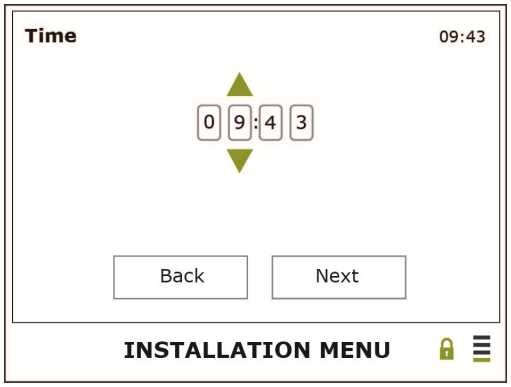


DD.MM.YYYY

Enter – Call up the date
Up – Increase present digit
Down – Decrease present digit
Right – Select next digit
Left – Select previous digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

4. Time



HH.MM (24 H)

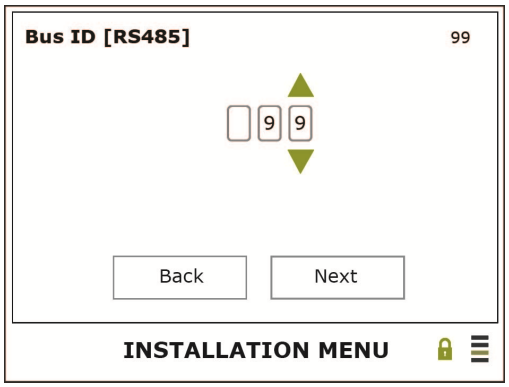
Enter – Call up the time
Up – Increase present digit
Down – Decrease present digit
Right – Select next digit
Left – Select previous digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

NOTICE

The time setting must match the time on the actual installation site, otherwise data may be overwritten!

5. Set Bus ID

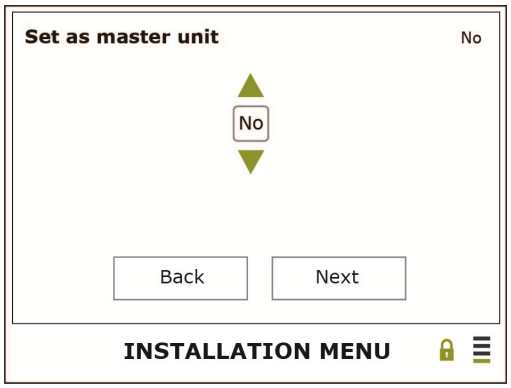


Enter – Call up the digits
Up – Increase present digit
Down – *Dec*rease present digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

If RS485 communication is used, set a unique bus ID for the inverter. For any follower inverters, this will be required to be set manually under ***Setup > Network Setup > Bus ID (RS485)***. If RS485 communication is not used, this step can be missed.

6. Set as Master Unit



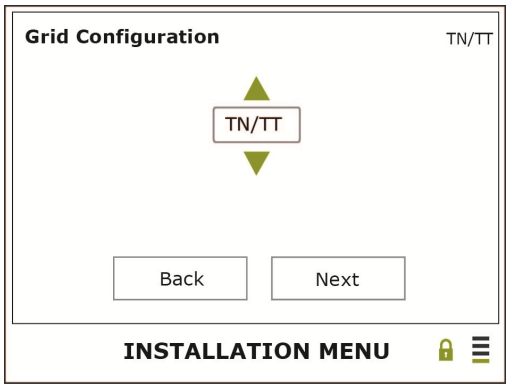
Default – No

Enter – Call up the options: Yes or No
Up – Yes
Down – No
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

If the inverter is set to master, data must be collected from the follower inverters. The following screen is displayed:

7. Grid Configuration

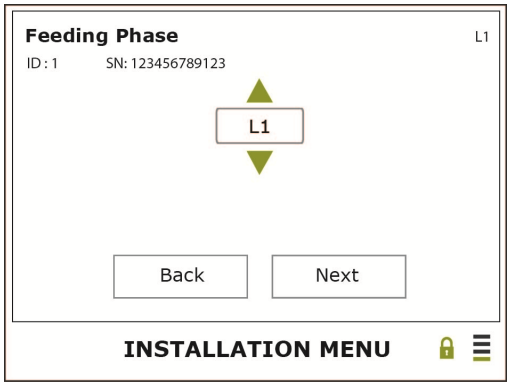


Enter – Call up the list of grid configurations
Up or Down – Select the grid configuration of the actual installation site:
TN/TT, *IT*, *Undefined*

Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

8. Feeding Phase



Enter – Call up the list of phases

Up or ***Down*** – Select the preferred phase:
- TN/TT: *Not set*, *L1*, *L2*, *L3*
- IT: *Not set*, *L1-L2*, *L1-L3*, *L2-L3*
Enter – Confirm

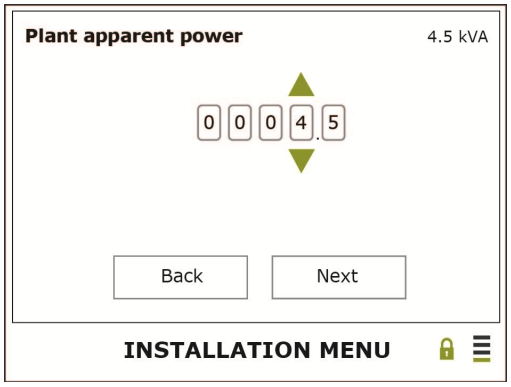
Left – Back
Right – Next
Enter – Confirm

If the inverter is set to master, and there is more than one inverter in the plant, the following screen is displayed:

If the inverter is configured as master: step through and set phase values (L1, L2, L3, L1-L2, L1-L3, L2-L3) for all follower inverters.

9. Plant Apparent Power

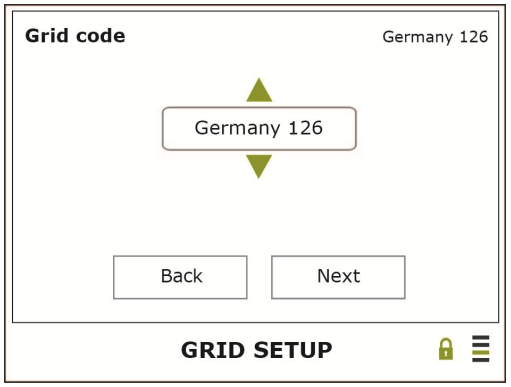
Plant apparent power is used to determining some *VDE 4105* default settings. The value shown in the installation menu is a suggestion and must be confirmed. Please call up the digits and change value if required before pressing ***Enter***.



Enter – Call up the digits
Up – Increase present digit
Down – Decrease present digit
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

10. Grid Code



Enter – Call up the list of grid codes
Up or ***Down*** – Scroll through the list to select the required grid code for the actual installation site:
Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

CAUTION

The selected grid code must match the actual installation site; otherwise the inverter may not operate or be compliant to relevant local and national regulations due to incorrect limit values.

NOTICE

- **UK:** Follow the local electrical regulations when selecting the grid code; either normal grid code setting or *UK 16A Limit* restricted grid code setting with a 16A limitation for G83 compliance.
- **Germany:** Follow the local electrical regulations when selecting the grid code setting; either *Germany 126* (VDE 0126-1-1) or *Germany 4105 (VDE-AR-N 4105)*.

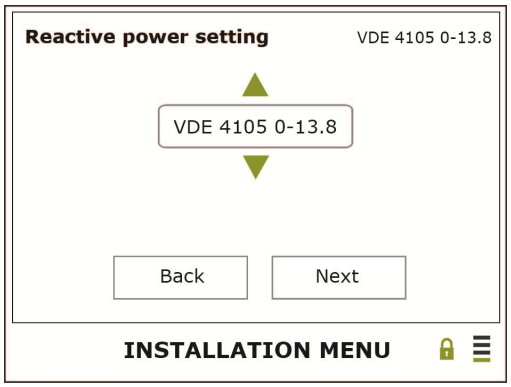
The following screen is displayed while the settings are updated:

Grid Code Selection

NOTICE

An installation timer ensures that the grid settings can be changed (using the *Owner* password) within **5 hours** of feeding power to the grid. Thereafter it is only accessible using the *Installer* password, which may only be obtained for installers and grid operators by contacting *Danfoss*.

11**. Reactive Power Setting**



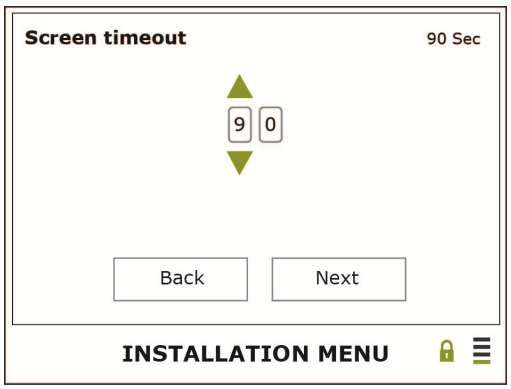
Enter – Call up the options

Select the actual reactive power setting:
1. For installations <= 13.8 kVA:
VDE 4105 0 – 13.8
2. For installations > 13.8 kVA:
VDE 4105 13.8 –

Enter – Confirm

Left – Back
Right – Next
Enter – Confirm

12. Screen Timeout



Enter – Call up the digits

Default – Screen backlight OFF after 60 sec

Left – Back
Right – Next
Enter – Confirm

NOTICE

The smallest value to be set is **30 sec**, and the highest is **99 sec**.
Setting the value to **0** disables the screen timeout and leaves the screen backlight ON at all times.

13. Customer Name

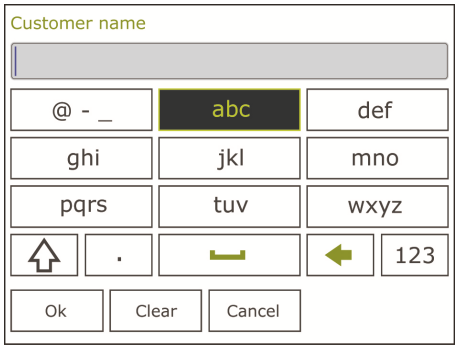
Enter – Call up the keyboard

The keyboard enables the typing of a customer name.

Left – Back
Right – Next
Enter – Confirm

In some of the submenus the settings must be typed by using the function keys:

Letter keyboard



Number keyboard

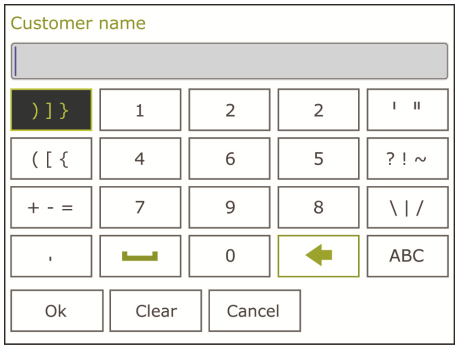


Table 5.2: Symbols appearing in the type screens

Symbol	Description	Symbol	Description
⇧	Upper- or lower-case letter	Ok	Confirm changes and exit the menu
.	Point	Clear	Clear the typing field
␣	Space	Cancel	Go back without saving changes
←	Cancel last letter	ABC	Go to the Letter keyboard
		123	Go to the Number keyboard

- *Enter* must be pressed until the wanted letter/number/symbol is shown.
- It is possible to navigate between the characters by using the *Up* arrow to set the marker into the text window, then using *Left* and *Right* to navigate between the characters.
- There is space for a maximum of 19 characters in the text window.

14. Site

Enter – Call up the keyboard

The keyboard enables the typing of a site name.

Left – Back
Right – Next
Enter – Confirm

15. Unit Name

Enter – Call up the keyboard

The unit name helps to distinguish and identify specific inverters in a large PV plant.

Left – Back
Right – Next
Enter – Confirm

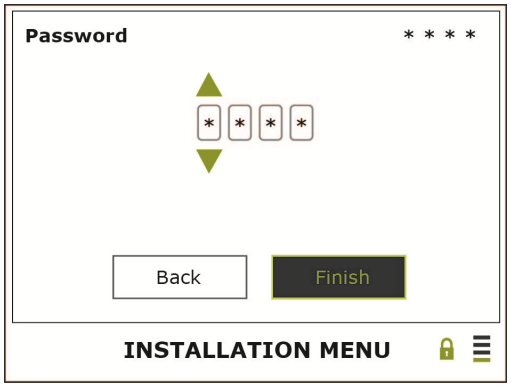
16. Message

Enter – Call up the keyboard

This message field is to help distinguish and identify specific inverters in a larger PV plant, or for any other information.

Left – Back
Right – Next
Enter – Confirm

17. Owner Password



Enter – Call up the digits
Default: 0003.
Change the password to 4 optional digits

Left – Back
Right – Finish
Enter – Confirm

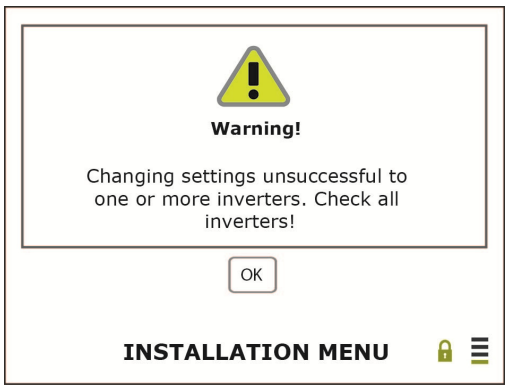
NOTICE

With several inverters connected it must be checked that the installation is carried out on all the follower inverters.

- Look at the displayed menu and the LEDs: It is **not** carried out correctly if the installation menu is still displayed and/or the green LED is **not** lit and the yellow and red LEDs are lit.
- Check that the connection of the CAN cables are correct, that the AC and DC switches are ON and that the voltage are **>184 V_{AC}**, and **>230 V_{DC}** and there is greater than **7 W_{DC}** of power
- If the *Start Up* phase is correctly carried out the inverters are ready to use. They are fully automatic during normal operation, and no manual control is necessary for feeding power into the grid.

A warning box is displayed if an error occurred during installation:

Warning Box



Errors:
1. No communication
2. Wrong grid settings

- Check the LEDs on the inverters. If the yellow and red are lit check that the installation is correct performed and that the grid settings are correctly set.
- If the '*Start Installation*' screen is still shown, run through the installation process on the inverter.

3.2. Self Test for Italy

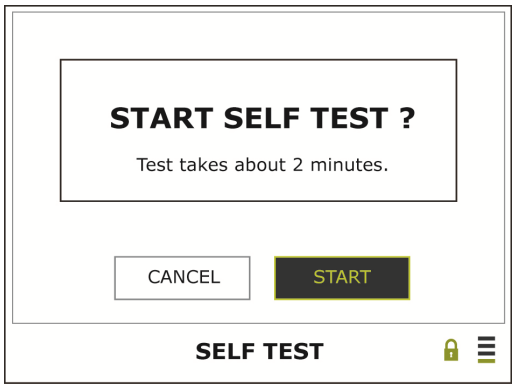
The *Self Test* function is only valid for installation in Italy. It tests the inverters' grid monitoring function of voltage and frequency, and takes approximately 2 minutes.

NOTICE

The Self-Test can only be activated when:

- The installation procedure is executed.
- The country setting is set to *Italy*.
- The inverter is in *Running/Derating Mode*.

Select: *Commands>Inverter Commands>Self Test*



- The inverter carries out four test sequences, all of which are displayed on the screen.
- After the test is finalized, each test result must be confirmed by entering ***Next***.
- After entering ***Finish*** on the last result, the screen displays the *Inverter Commands* menu.
- The test results can be found in *Commands>Inverter Commands>Results Self Test.*

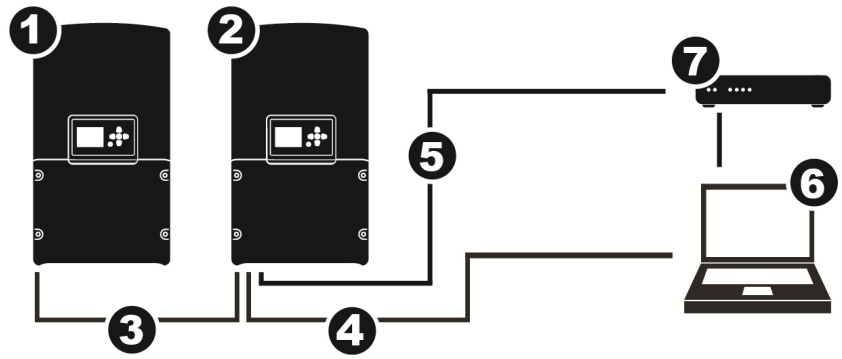
Refer to *User Guide* for more detailed information about the *Italian Self Test*

4. Connection between Inverter and PC

The site performance can be checked remotely by using a computer. The connection can be achieved between the inverter and the computer either directly or via a network.

4.1. Without a Network

To connect the inverter and the computer directly a regular Ethernet cable is needed. If the network card in the computer does not support *Autosense*, a crossover cable is needed to create a connection to the inverter.



1. Follower inverter
2. Master inverter
3. CAN bus cable
4. Ethernet cable
5. RS-485 cable
6. Computer
7. Data logger

Figure 4.1.1:Connection without network

NOTICE

With several inverters connected together via CAN bus the Ethernet cable must be attached to the **master** inverter only.

4.1.1. IP Address

The computer's and the inverter's IP address must be in the same range. If the inverter's IP address is *192.168.10.X*, the computer's IP address must be *192.168.10.Y*, where X and Y are different numbers between 1 and 254.

Inverter

The inverter's default IP address is *192.168.10.20*. To change the IP address, go to ***Setup***>***Network Setup*** and set the inverter's IP address as required.
To connect the PC and the inverter, the inverter's IP address must be entered into the PC web browser address line.

Refer to *User Guide* for more detailed information about Network setup

5. Internal Web Server

The inverter has an internal, onboard web Server providing detailed information about the operation, warning/alarms and energy production from the inverter/plant.

- The web page is best viewed in *Firefox 6.0* and *Internet Explorer 8.0* or later versions.
- From the web page certain inverter settings can be changed after applying the correct user name and password.
- Type the inverter's IP address in the computer's web browser.
- Default administrator account is: **User:** *admin*, **Password:** *admin*.
  This can be changed by user, and should be changed if the web server is connected to the internet.

5.1. Home

The *Home* screen is the standard display, which is always shown when opening the web server.

Figure5.1: Web Server Home screen

6. Troubleshooting

This chapter contains useful information if the inverter malfunctions during start-up or operation. Start by checking that the installation is carried out correctly, and then check the information in section 4.2 for possible solutions. If this does not help solve the problem, please contact the system installer.

6.1. Check List by Failure

If the inverter does not feed power to the grid, try to solve the problem by checking:

☑ That the irradiation is sufficient to generate power (>7 W).
☑ That both the AC circuit breaker(s) and DC switch(es) are **ON**.
☑ That the operation mode of the LEDs is normal. Refer to *3.1.2.2. LED*.
☑ That there are no warnings or alarms in the display.
☑ That all connection points in the system are properly tightened.
☑ That the values of the PV voltage, current and power match those in the display.

If all these items are OK, and there is still no power fed to the grid, please contact the system installer.

6.2. Table of Events

The inverter automatically identifies operational issues and displays the messages on the screen. Detailed information about warnings and alarms can be found in the *Event Log* menu.

Messages that can appear in the display:

W = Warning: inverter continues to operate at highest possible capacity (Yellow LED
A = Alarm (Red LED)

The Display Message code number (E01, E02, etc..) is the code shown in the event description as displayed in the Event Log of the webserver view:

Table 7.1: Description of messages appearing in the display during inverter failure

Display Message	Description	Action
Panel fault (**W/A – E01**)	PV module failure	- Contact the module supplier*
Input circuit breaker open (**A – E02**)	DC switch(es) is open	- Turn ON the DC switch(es)* - If already ON, contact the system installer
Inverter failure (**W/A – E03**)	Inverter failure	*
Output circuit breaker open (**A – E04**)	AC circuit breaker(s) is open	- Turn ON the AC circuit breaker(s)* - If already ON, contact the system installer

Display Message	Description	Action
Grid fault (**W/A – E05**)	No detection of the grid, not able to synchronize with the grid or fault within the country-settings	- Verify if the AC circuit breaker is ON and operational - Measure that the grid voltage is present at the AC terminals - Check that the DC switch(es) is ON and that the DC power is > 7W - Check that the country settings have been successfully set in *Setup>Grid Setup* - If country is set to Italy, has the *Self-Test* failed. Run test again
GUI fault (**W/A – E06**)	Display is not responding	- Turn off the AC side. Wait for 3 seconds and then turn on again. Wait 30 seconds for the GUI to turn on - If still fault, contact your distributor
High voltage on input side (**A – E07**)	DC voltage threshold of 600 V_{DC} is exceeded	- Contact system installer
Low voltage on input side (**A – E08**)	DC voltage is too low to operate the inverter	- Fault is cleared automatically when PV voltage exceeds 230 V - If the inverter remains in this fault during daylight, and the V_{DC} is >230V, contact your distributor
Low PV isolation resistance (**W – E09**)	PV isolation resistance is below permitted level	- The grounding setup is configured incorrect - Check the jumper for the grounding setup (*Jumper Position for the System Grounding Setup*) - If the jumper is correct positioned, contact the supplier
Failure on DC side (**W/A – E10**)	Inverter failure on the DC side	- Failure on the DC side. Other **W/A** will be displayed - If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Failure on AC side (**W/A – E11**)	Inverter failure on the AC side	- Failure on the AC side. Other **W/A** will be displayed - If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
High inverter temperature (**W/A – E12**)	Maximum permissible internal inverter temperature is exceeded	- Check that the ambient temperature is within the specification. Refer *to 9. Technical Data* - Check if the ventilation is sufficient, the minimum distances are compliant with those stated in this *User Manual* and the inverter is shielded from direct sunshine - Clean ventilation area. Refer to *User Guide*.
Low inverter temperature (**W/A – E13**)	Low internal inverter temperature	- Contact your distributor

Display Message	Description	Action
Current / power limitation (**W/A – E14**)	PV power exceeds inverter rating	- The inverter will try to start up again when the temperature is within the permissible range again - Check if the ventilation is sufficient, the minimum distances are compliant with those stated in this manual and the inverter is shielded from direct sunshine - Clean ventilation area. Refer to *User Guide*.
Communication failure (**A – E15**)	Internal communication failure	- If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Fan failure (**W/A – E16**)	Internal air circulation has failed	- Contact your distributor for replacement
Fuse fault (**A – E17**)	One or more fuses or circuit breakers are blown, or the jumper for the grounding setup is positioned incorrect	- Check the jumper position (*2.4.3.4. Jumper Position for the System Grounding Setup*) - Contact the system installer for DC fuse replacement
Active power limitation (**W/A – E18**)		*
Reactive power compensation (**W/A – E19**)		*
Microprocessor fault (**W/A – E20**)		- If the inverter is in *Shutdown*, turn off the AC side and then the DC side. Wait for 30 seconds, then turn on the AC side and then the DC side - If the fault persists, contact your distributor
Ground current trip (**A – E21**)		*
High AC voltage (**A – E22**)	Too high AC voltage, the inverter stops feeding power	- The inverter will restart when the voltage is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
Low AC voltage (**A – E23**)	Too low AC voltage, the inverter stops feeding power	- The inverter will restart when the voltage is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer

Display Message	Description	Action
High frequency on output side (**W/A – E24**)	The frequency of the utility voltage is above the upper limit	- The inverter tries to restart when the frequency is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
Low frequency on output side (**W/A – E25**)	The frequency of the utility voltage is below the lower limit	- The inverter tries to restart when the frequency is within the permissible range - Check that the country settings have been successfully set in *Setup > Grid Setup* - If the failure persists, contact the system installer
High output DC current (**W/A – E26**)	Too high proportion of DC current in the grid feed	- The inverter tries to restart when the fault is cleared - If the fault still occurs, contact your distributor
Output current imbalance (**W – E27**)	Imbalance in the output current between the phases (3 phase only)	*
Grid fault, still running (**W – E28**)	Fault ride-through	*
VDR fault DC side (**W – E29**)	The varistors on the DC side are damaged.	- Contact your distributor for new parts

* Reserved for future use

7. Maintenance and Disposal

Regular inspection of the PV system is an important safety precaution to ensure trouble-free operation of the entire PV plant and the *DLX* inverter.
Danfoss is committed to its policy of environmental responsibility, and therefore appeals to end users who are disposing of inverters to follow local environmental legislation and to seek safe and responsible means of disposal.

7.1. Regular System Inspection

The *DLX* inverters are designed and manufactured to operate trouble-free for many years. Performing regularly maintenance will ensure high efficiency and a longer service life for the inverters.

NOTICE

- Prior to service and maintenance work the inverter should always be disconnected on both the AC and the DC sides and discharged to avoid shock hazards.
- For service or maintenance the inverter must be de-energized for **1 hour** to discharge the capacitor bank.
- The inverter upper cover is to be opened only by *Danfoss* service persons or service partners authorized by *Danfoss* due to danger of damage to internal components and invalidated warranty.

Refer to *User Guide* for more detailed information about the discharge procedure of the capacitor bank and about regularly maintenance of the inverter.

8. Warranty

The inverters are compatible with all relevant standards and are guaranteed to be free of defects from the date of purchase.

8.1. Warranty Disclaimer

The warranty is void through misuse or when unauthorized repairs are performed on the inverter. The warranty does not cover normal wear and tear of the inverters or costs related to installation and troubleshooting of the electrical system. The warranty is only valid with an identifiable and accepted serial number.

8.1.1. Damage

Danfoss takes no responsibility for damages to the inverter due to:

- Unauthorized persons removing the inverter upper cover.
- Unauthorized modifications made to the inverter.
- Inverter is installed, commissioned, operated or maintained incorrectly.
- Relevant safety regulations and instructions in this *User Guide* being ignored.
- Inverter operating beyond the limit values given in the 9. Technical Data
- Inverter exposed to external abnormal conditions such as lightening, storms, fire, vandalism etc.

8.2. End of Life Disposal

- In case of return as a result of end of service life, the inverter can be returned to your local distributor or disposed of in the respective country.
- The shipping is paid by sender. Recycling and disposal of the *DLX* inverter must be done according to the rules and regulations applicable in the country of disposal.
- All material used for the packaging is recyclable.

9. Technical Data

	Parameter	DLX 2.0	DLX 2.9	DLX 3.8	DLX 4.6
	AC				
|S|	Rated apparent power	2000 VA	2900 VA	3800 VA	4600 VA
P	Rated active power @ cosphi = 1	2000 W	2900 W	3800 W	4600 W
Q	Reactive power range	0-1600 VAr	0-2320 VAr	0-3120 VAr	0-3680 VAr
	Controlled power factor range	0.8 over-excited, 0.8 under-excided			
$V_{ac,r}$	Rated output voltage	230 V			
$V_{ac,\,min}$; $V_{ac,\,max}$	AC voltage range (P-N. P-P)	230 V±20%, single or split phase			
	Nominal output current	9.0 A	13.0 A	17.0 A	20.0 A
I_{acmax}	Max output current	10.5 A	15.2 A	19.7 A	23.0 A
	AC current distortion (THD %)	2.59%		3.36%	
Cosphi $_{ac,r}$	Power Factor (cos φ)	0.8 over-excited, 0.8 under-excided			
	Night-time power loss	< 1 W			
f_r	Mains frequency	50 Hz			
f_{min}, f_{max}	Grid frequency range	50 Hz ± 5 %			
	DC				
	Nominal DC power	2100 W	3000 W	4000 W	4800 W
	Max recommended PV power	2625 W	3750 W	5000 W	6000 W
$V_{dc,r}$	Nominal voltage DC	220 – 480 V			220 - 480 V
V_{mppmin} V_{mppmax}	MPP voltage-nominal power	230 – 480 V			250 - 480 V
	MPP efficiency	99.9%			
	Max. DC voltage	600 V			
	Turn on voltage	230 VDC			
	Turn off voltage	220 VDC			
	Max current DC	9.5 A	13.5 A	18.0 A	21.0 A
	Max. short circuit current DC at STC	9.5 A	13.5 A	18.0 A	21.0 A
	Min. on grid power	7 W			
	Efficiency				
	Maximum efficiency	97.2 %	97.2 %	97.2 %	97.3 %
	CEC efficiency	96.8 %	96.8 %	97.0 %	97.0 %
	EU efficiency	96.3 %	96.5 %	96.7 %	96.9 %
	Other				
	Dimensions	610 x 353 x 158 mm(169.5 mm with bracket)			
	Mounting recommendation	Wall bracket			
	Weight	19 kg		21 kg	
	Sealing grade	IP65			
	Acoustic noise level	< 37dB (A)			
	Operation temperature range	-25 to +65 °C (Possible power derating above +45 °C)			
	Storage temperature	-30 °C to + 80 °C			
	Relative humidity	4 to 99%			
	Number of PV string inputs	3			
	Number of MPP trackers	1			
	Protection against excessive PV power	Yes			
	Overvoltage category AC / DC	Class B / Class B			
	Reverse polarity protection	Yes			
	Ground fault monitoring	Yes			
	Integral DC switch	Yes			
	PV grounding	Field configurable for ungrounded, positive grounded or negative grounded			
	Topology	High frequency transformer, galvanic isolation			
	Performance monitoring	Graphical colour display with 6 touch sense buttons, 3x LEDs for visual status indication, Built-in Web Server			
	PV connection	SunClix			
	AC/grid connection	Screw terminals			
	Ethernet	1 x RJ45			
	RS-485 / CAN	Screw terminals			
	Functional safety				
	Safety (protective class)	Class I			
	Islanding detection/ loss of mains	Active Frequency Shift			
	RCD type A recommendation	Yes			
	Indirect contact protection	Yes, (Start class I, grounded)			
	Voltage & frequency surveillance	Included			
	Insulation resistance surveillance	Included			
	DC content of AC current surveillance	Included			

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